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2004/00155

Sertifikaat

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REPUBLIC OF SOUTH AFRICA

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the documents annexed hereto are true copies of:

Application forms P.1, P,2, provisional specification and drawings of South African Patent Application 2003/9329 as originally filed in the Republic of South Africa on 1 December 2003 and post-dated to 10 December 2003 in the name of ZACHARIAS JOSEPH VAN DEN BERG for a n invention entitled: "LIQUID TRANSFER EQUIPMENT AND TREATMENT INSTALLATION ."

Geteken te PRETORIA in die Republiek van Suid-Afrika, hierdie dag van
Signed at PRETORIA in the Republic of South Africa, this 24nd day of August 2005

Registrateur van Patente
Registrar of Patent

G.P.-S. 019-0194

FORM P 2

(To be lodged in duplicate)

REPUBLIC OF SOUTH AFRICA

PATENTS ACT, 1978

REGISTER OF PATENTS

Official application No.	Lodging date: Provisional 10.12.03	Acceptance date
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Full name(s) of applicant(s)/Patentee(s):

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Applicants substituted:	Date registered
71	

Assignee(s):	Date registered
71	

Full name(s) of inventor(s):

72 Zacharias Joseph VAN DEN BERG

Priority claimed	Country	Number	Date
	33	31	32
	33	31	32
	33	31	32

Title of invention

54 LIQUID TRANSFER EQUIPMENT AND TREATMENT INSTALLATION

Address of applicant(s)/Patentee(s)

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Address for service P O BOX 3771, GLENHARVIE, 1786

74

Patent of addition No.	Date of any change
61	
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P 015 (E)

REPUBLIC OF SOUTH AFRICA
PO 32
PATENTS ACT, 1978

APPLICATION FOR A PATENT AND ACKNOWLEDGEMENT OF RECEIPT

(Section 30(1)-Regulation 22)

(i)

Official application No.	Applicant's or agent's reference
21 01 2003/9329	

(ii) 71	Full Name(s) of Applicant(s).	Zacharias Joseph VAN DEN BERG
(iii)	Address(es) of Applicant(s).	9 COOPERSKLOOF STREET, GLENHARVIE, SOUTH AFRICA
(iv) 54	Title of Invention	LIQUID TRANSFER EQUIPMENT AND TREATMENT INSTALLATION

(v) The applicant claims priority as set out on the accompanying P2.

(vi) This application is a patent of addition to Patent Application No.
21 01.

(vii) This application is a fresh application in terms of section 37 and based on Application No.
21 01.

(viii) This application is accompanied by:

X	1.	A single copy of a provisional and two copies of the complete specification of 11 pages.
X	2.	Drawings of 3 pages.
	3.	Publication particulars and abstract (form P8 in duplicate)
	4.	A copy of Figure of the drawings (if any) for the abstract
	5.	An assignment of invention.
	6.	Certified priority document(s) (state number)
	7.	Translation of priority document(s)
	8.	An assignment of priority rights.
	9.	A copy of the form P2 and the specification of S.A. Patent application No. 21 01
X	10.	A declaration and power of attorney on form P3.
	11.	Request for ante daring on form P4.
	12.	Request for classification on form P9
	13.	

(ix) 74 Address for Service: P O BOX 3771, GLENHARVIE, 1786

Dated this 25th day of NOVEMBER 2003.

Signature of applicant(s) or agent

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REGISTRATEUR VAN PATENTE, MODELLE, HANDELSMERKE EN OUTEURSREG

REPUBLIC OF SOUTH AFRICA
PO 32
PATENTS ACT, 1978
FORM P1

APPLICATION FOR A PATENT AND ACKNOWLEDGEMENT OF RECEIPT

(Section 30(1)-Regulation 22)

REGISTRATEUR VAN PATENTE, MODELLE, HANDELSMERKE EN OUTEURSREG

(i)

Official application No.	
21 01:	2003/9329

Applicant's or agent's reference

(ii)

71	Full Name(s) of Applicant(s).	Zacharias Joseph VAN DEN BERG

(iii)

	Address(es) of Applicant(s).	9 COOPERSKLOOF STREET, GLENHARVIE, SOUTH AFRICA

(iv)

54	Title of Invention LIQUID TRANSFER EQUIPMENT AND TREATMENT INSTALLATION

(v)

	The applicant claims priority as set out on the accompanying P2.

(vi)

	This application is a patent of addition to Patent Application No.
21	01.

(vii)

	This application is a fresh application in terms of section 37 and based on Application No.
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REGISTRATEUR VAN PATENTE, MODELLE, HANDELSMERKE EN OUTEURSREG

REPUBLIC OF SOUTH AFRICA
PATENTS ACT, 1978

Declaration and Power of Attorney
(Section 30 - Regulation 8, 22(1) (c) and 33)

Patent Application number	Lodging date
21 02 2003/9329	2003-12-01

Full Name(s) of Applicant(s)
71 Zacharias Joseph VAN DEN BERG

Full Name(s) of Inventor(s)
72 Zacharias Joseph VAN DEN BERG

Priority claimed	Country	Number	Date

Title of Invention
54 LIQUID TRANSFER EQUIPMENT AND TREATMENT INSTALLATION

I, Zacharias Joseph VAN DEN BERG

hereby declare that-

(1) I am the applicant mentioned above;

(2) to the best of my knowledge and belief, if a patent is granted on this application, there will be no lawful grounds for the revocation of the patent.

Signed at GLENHARVIE this 25th day of NOVEMBER 2003

Applicant

REPUBLIC OF SOUTH AFRICA

FORM P6

PATENTS ACT, 1978

PROVISIONAL SPECIFICATION
(Section 30(1) - Regulation 27)

Official Application Number	Lodging Date
21 01 — 2003/9329	22 — 2003-12-01

Full Name(s) of Applicant(s)

71

Zacharias Joseph VAN DEN BERG

Full Name(s) of Inventor(s)

72

Zacharias Joseph VAN DEN BERG

Title of Invention

54

LIQUID TRANSFER EQUIPMENT AND TREATMENT INSTALLATION

(1) TITLE OF THE INVENTION

LIQUID TRANSFER EQUIPMENT AND TREATMENT INSTALLATION

(2) FIELD OF THE INVENTION

THIS INVENTION relates to liquid transfer equipment employable under conditions where a large volumetric flow rate at low pressure is required. The invention also relates to the biological or bacteriological treatment of wastewater, such as sewage, in a plant using the liquid transfer equipment forming the one aspect of this invention.

(3) SUMMARY OF THE INVENTION

According to one aspect of the invention there is provided submersible high volume and low pressure liquid transfer equipment at least employable for transferring liquid against a small head inclusive of a recirculatory flow of liquid between chambers, once installed comprising

a stirrer type rotor,

a housing within which the rotor is mounted to freely rotate though in a way that promotes the effective intake and throughput of liquid at least once the equipment is assembled and positioned for use if so assemblable, and which housing defines a liquid transfer chamber extending between at least one location of liquid intake and a tangentially arranged discharge with the equipment being couplable to a drive to cause the rotor to rotate at a

conventional stirrer type speed of rotation, the equipment once used for performing a recirculatory function being located to transfer liquid at a low elevation from a chamber within which it is positioned that further provides for a return flow from a recirculating chamber that is thus maintained once the equipment is so operatively used owing to the creation of a hydrostatic head favouring the return flow from such reciculating chamber to such equipment holding chamber while a favourable hydrostatic head is also in the appropriate case created when the equipment is used for performing a downstream transfer function from an upstream supply chamber.

The housing may promote the effective intake of liquid by being formed to present an intake that is situated axially as regards the axis of rotation of the rotor from at least one of its sides.

The housing may preferably be formed with one intake thus being centrifugal pump housing fashion shaped.

The rotor may be in the form of a base plate situated remote from the intake of the housing, at least once located for use, carrying a plurality of regularly circumferentially arranged blades as thus facing the intake.

The equipment may be arranged to be mounted to cause the rotor to rotate about a vertical axis with the housing being positionable above the floor of a chamber within which it is located, once in use, when the intake is from below when so positioned.

The equipment may be arranged to be positionable above the floor of a chamber within which it is located, once in use, when the intake is from below, by the housing being couplable with a number of circumferentially spaced raisers if not incorporating such.

The rotor may be fitted with a drive shaft that is of adequate length to enable its coupling to a non-submersed rotor drive once installed for use.

When arranged to rotate about an upright axis and at least with the intake to the housing being from below, once the equipment is installed, the housing may incorporate an open ended rotor shaft sleeve along which the rotor extends at least once the equipment is installed for use, that is of adequate length to cause its upper end to remain above the level of liquid in an equipment situated chamber once the equipment is in use.

According to another aspect of the invention there is provided a liquid transfer facility comprising

means defining at least one chamber presenting a low level outlet and at least one location of inlet and that houses submersible liquid transfer equipment, as described, that is connected to a drive, and which equipment is installed within the chamber in a way that causes its discharge to be in close vicinity of the chamber outlet if not matching it, to the effect of transferring liquid from the chamber via the outlet once the facility is in use.

The inlet to and the outlet from the chamber may preferably be in the form of ports.

The size of at least the inlet port may preferably be adjustable by way of an adjusting mechanism.

In an embodiment the adjusting mechanism may be in the form of a sluice mechanism thus having a sluice gate to achieve such adjustment.

In a preferred embodiment the liquid transfer facility may include at least two chambers that are interconnected by a low level port serving as discharge for the chamber within which the liquid transfer equipment is installed in transferring liquid to the receiving chamber and a return port for causing the recirculation of at least part of liquid transferred from the equipment housing chamber to the receiving chamber back to the equipment housing chamber owing to the creation of a hydrostatic head favouring such return.

In a further development the liquid transfer facility may incorporate yet a further chamber that is in flow communication with the transfer equipment housing chamber via a transfer port, the various chambers thus being employable for the continuous charging of liquid from the further chamber to the transfer equipment housing chamber and the recirculation effect between the transfer equipment housing chamber and the receiving chamber for the treatment of liquid as achieved by the facility once in use.

According to yet another aspect of the invention there is provided a liquid treatment installation that includes

a primary reactor vessel defining a zone of primary treatment,

a secondary reactor vessel defining a secondary treatment zone, and

an intermediate vessel situated intermediate the primary and secondary treatment vessels that in a way houses submersible liquid transfer equipment, as described, for causing its discharge to be in flow communication via a low level intermediate vessel outlet port with the

primary treatment vessel while the intermediate vessel is in charging flow communication with both the primary and secondary treatment vessels via low level charging ports.

The intermediate vessel may be in the form of a sump, the outlet port and adjustable inlet ports thus being arranged at a low level in the sump.

The sizes of the outlet ports may preferably be adjustable.

The sump may preferably be of small volumetric capacity as compared to the reactor vessels

The inlet ports may comprise sluices and may conveniently be adjustable by means of displaceable sluice gates.

The primary reactor vessel may be chargable from a charging source via which liquid required to be treated is charged to the installation once in use.

The primary reactor vessel may also have an outlet via which it is in liquid flow communication with another vessel in the appropriate case being the secondary treatment vessel or alternatively being one of a series of reactor vessels in a liquid treatment system.

The secondary reactor vessel may have an inlet for receiving liquid desired to be treated and an outlet for discharging liquid from the secondary treatment zone into a further treatment zone.

The submersible liquid transfer equipment during operation of the installation thus circulating liquid between the primary reactor vessel and the sump via the primary vessel to sump inlet port and the sump outlet port causing the contents of the primary treatment zone to become properly mixed and to transfer liquid from the secondary reactor vessel to the primary reactor vessel via the sump through the secondary reactor vessel to sump inlet port. Suitable adjustment of the various inlet ports to the sump give rise to desired positive hydrostatic heads between the primary and secondary reactor vessels and the sump owing to the lowering of the level in the sump relative to the reactor vessels in response to operation of the stirrer type liquid transfer equipment. The inlet ports are preferably appropriately set to cause the hydrostatic head between the primary reactor vessel and the sump to be larger than that between the secondary reactor vessel and the sump. This promotes the circulatory flow of liquid between the primary reactor vessel and the sump. Similarly the hydrostatic pressure arising between the secondary reactor vessel and the sump promotes the flow of liquid from the secondary reactor vessel to the sump where it becomes entrained in the

mixing flow stream. This facilitates mixing of the contents of the primary reactor zone while liquid from the secondary treatment zone becomes entrained in the flow stream between the primary treatment zone and the sump.

In a preferred embodiment the liquid treatment installation may form part of a sewerage treatment system. When so used the primary reactor vessel can be either the anoxic reactor of such system or the anaerobic reactor. The secondary reactor vessel can either be the aerobic reactor or also an anoxic reactor.

The liquid treatment installation may also include

a tertiary reactor vessel in flow communication with the secondary reactor vessel while and defining a tertiary treatment zone, and

a further intermediate vessel situated intermediate the secondary and tertiary treatment vessels that in a way houses further submersible liquid transfer equipment, as described, for causing its discharge to be in flow communication via a low level intermediate vessel outlet port with the secondary treatment vessel while the further intermediate treatment vessel is in charging flow communication with both the secondary and tertiary treatment vessels via low level charging ports.

Similarly to as described above, the inlet ports of the further intermediate vessel may be in the form of sluices and may be adjustable by means of sluice gates while the secondary intermediate vessel may be in the form of a sump.

The installation including primary, secondary and tertiary reactor vessels may comprise part of a water purification plant.

In a preferred embodiment the tertiary reactor vessel may be in the form of an aerobic reactor.

The installation may include one or more aerators operatively arranged in relation to the tertiary reactor vessel to aerate its liquid treatment zone. The installation may include still further vessels defining further treatment zones to provide a series of liquidly interconnected treatment zones.

The installation may also include a separator that may be in the form of a conical separator that may further be supplied from the tertiary reactor vessel via a launder that is fed by the aerators operating as a liquid transfer means.

In use sludge separated in the separator may either be returned from a lower region of the separator into the tertiary reactor vessel or, depending on the water treatment protocol used, may be directed into one of the primary or secondary reactor vessels.

Two adjacent reactor vessels of the installation may be separated by a common dividing wall and may be surrounded peripherally by the tertiary reactor vessel that extend annularly with respect to the other vessels.

The tertiary reactor vessel may be separated from the primary and secondary reactor vessels by a boundary wall. It is indeed an advantage of the configuration described that a reinforced ditch that is oval in plan and of a cycle-track (or dished) cross-section, may be constructed. In this construction a generally ovally extending internal separating wall as spaced from the perimeter thus defines a boundary between the tertiary treatment vessel and the primary and secondary treatment vessels respectively.

A further transverse boundary wall extending at an angle to the longitudinal axis of the ditch and may serve to define a common boundary between the primary and secondary reactor vessels. The sumps between the various reactor vessels may be located at respective intersections of the first and second internal boundary walls.

In use and in a known biological sewerage treatment procedure sewerage effluent is transferred into a primary phase of treatment. Treated liquid is then transferred to an anoxic reactor for secondary phase treatment. The liquid id finally fed to an aerobic reactor. Liquid from the aerobic reactor in due course goes to a settler. The protocol requires that a predetermined quantity of residue from the anoxic reactor is recycled into the anaerobic reactor. Further, in a second recycle stage a predetermined quantity of residue from the aerobic reactor is recycled into the anoxic reactor. Still further, settled sludge from the settler may be recycled into one of the reactor, normally the aerobic reactor.

(4) BRIEF DESCRIPTION OF THE DRAWING

In the drawings:

Figure 1 shows in partly cut away side elevation submersibly positionable liquid transfer equipment, according to one aspect of the invention, in the form of a stirrer type transferring device as installed,

Figure 2 shows the device in plan view along section line A-A in figure 1,

Figure 3 shows the device from below,

Figure 4 shows in plan view a liquid treatment installation, according to another aspect of the invention,

Figure 5 shows the installation in sectioned end elevation along section line B-B in figure 4,

Figure 6 shows in plan view detail the positioning of the device into an intermediate transfer chamber forming part of the installation,

Figure 7 shows in diagrammatic side elevation detail the positioning of the device into an intermediate transfer chamber forming part of the installation, and

Figure 8 shows a flow diagram of a water treatment procedure.

(5) DETAILED DESCRIPTION OF THE DRAWINGS

Referring to figures 1 to 3 of the drawings liquid transfer equipment in the form of a stirrer type device is generally indicated by reference numeral 10.

The device 10 comprises a stirrer type rotor 12 situated to freely rotate within a centrifugal pump type housing 14 once operatively installed via a rotor shaft 16 forming a rotor and shaft combination 18. The housing 14 thus defines a liquid transfer chamber 20 extending between an axially arranged inlet 22 facing downward and a tangentially arranged outlet 24.

The device 10 is configured to be mounted and installed to rotate about the axis of rotation 26 of the rotor 12. As the inlet 22 is from below the device 10 must be maintained in an elevated position relative to the floor of a chamber within which used. To this effect the housing 14 is fitted with leg plates 28 extending radially between the periphery of the housing 14 up to the inlet 22. The housing 14 is integrally fitted with a rotor shaft sleeve 30 that thus

extends above the body of the housing 14 once operatively installed. The rotor 12 is consequently open from above once the device 10 is operatively installed.

The rotor 12 is conventionally fitted with stirrer blades 32 that are regularly arranged about the axis of rotation 26. The blades 32 are integrally mounted to a head plate 34 from which the shaft 16 extends. The combination 18 is rotatably driven from a drive in the form of a gearbox and motor assembly 36 that does not necessarily form part of the device 10. The rotor 14 is driven at a conventional stirrer type speed of rotation.

As the rotor and shaft combination 18 is freely suspended within the housing 14 it is so operatively maintained owing to the shaft 16 being bolted to the drive assembly 36 while the various dimensional parameters of the device 10 are suitably selected to ensure that the rotor and shaft combination 18 freely rotates within the housing 14 and the sleeve 30 once in use.

Referring to figures 6 and 7 the device 10, as of high volume and low-pressure characteristics, is thus installable in a liquid transfer chamber in the form of a sump 38 for transferring liquid between one or more chambers 40 and the sump 38. Although not shown in detail the device is installed by way of anchoring guides extending upward from the floor of the sump 38 that promote the ease of retraction of the device 10 from the sump 38 by simply lifting it away. As more clearly shown in figure 6 the device is naturally installed with its outlet 24 facing a sump discharge in the form of a port 42 situated at a low level while its inlet 22 faces downward. The object of the device 10 is to transfer liquid against a small head inclusive of a circulatory transfer between the chamber 38 and the chamber(s) 40. As running of the device 10 has the effect of drawing the level in the sump 38 below that of the levels in the adjacent chamber(s) 40, as shown in figure 7, a positive hydrostatic head is created in the direction of the sump 38 owing to the suction effect thus causing liquid to continuously flow from the chamber(s) 40 to the sump 38 via sump inlets in the form of inlet ports 44 once the device 10 is running. As discussed below when used under practical circumstances, the device 10 is thus amongst others employable to achieve a proper mixing effect of liquid in, for example, the chamber(s) 40 owing to the effect of the hydrostatic head. The length of the sleeve 30 suitably selected so that liquid in the sump 38 cannot overflow into the chamber 20 of the device 10 even when not in use. The level of the liquid within the sleeve 30 is naturally under all circumstances at the same elevation as that in the sump 38.

The liquid within the sleeve 30 thus forms a seal against overhead liquid flow into the chamber 20 once the device 10 is in use.

The device 10 is usefully employable in conjunction with a liquid treatment installation. In referring to figures 4 to 8 a liquid treatment installation, as another aspect of the invention, in the form of a sewage treatment plant is generally indicated by reference numeral 50.

The plant 50 presents a generally oval structure 52 with associated settling tank 54. The structure 52 has a peripheral outer wall 56, and an inner wall 58 spaced inwardly there from. A transverse wall 60 extends obliquely across the oval formation defined by the inner wall 58, thereby forming a primary reactor vessel 62 and an adjacent secondary reactor vessel 64 within the oval formed by the wall 58. A tertiary reactor vessel 66 of elongate-annular shape and cycle-track cross-section is defined by the spaced walls 58 and 56, around the reactor vessels 62 and 64.

A primary reactor vessel to secondary reactor vessel transfer chamber in the form of a sump 68 is situated at one end of the wall 60, within which sump 68 a device 10 is installed in a way as described above with reference to figures 6 and 7. The sump 68 has a limited volumetric capacity and has an outlet port 68.1, and adjustable inlet ports in the form of a first inlet sluice 68.2 with adjustable sluice gate and a second inlet sluice 68.3 with adjustable gate for varying flow rates into the sump 68.

A secondary reactor vessel to tertiary reactor vessel transfer chamber in the form of a sump 70 as also fitted with a device 10 is situated at the other end of the wall 60. The sump 70 is effectively of the same construction as the sump 68 and presents an outlet port 70.1, a first inlet sluice 70.2 with adjustable sluice gate and a second inlet sluice 70.3 with adjustable gate for varying flow rates into the sump 70.

The sumps 68 and 70 are small in volume in comparison with their associated reactor vessels 62, 64 and 66. Adjustment of the gates of the sluices 68.2, 68.3 and 70.2 and 70.3 and operation of the devices 10.1, 10.2 result in a lowering in the level of liquid in the sumps 68, 70 causing positive first hydrostatic liquid heads between the liquid in the primary and secondary reactor vessels 62 and 64 respectively and the sump 68 and between the secondary and tertiary reactor vessels 64 and 66 respectively and the sump 70. The gates are preferably adjusted to cause the hydrostatic head between the primary reactor vessel 62 and the sump 68 and the secondary reactor vessel 64 and the sump 70 to always be larger

than the hydrostatic head between the secondary reactor vessel 64 and the sump 68 and the tertiary reactor vessel and the sump 70. This difference causes liquid to flow from the primary reactor vessel 62 though the inlet-sluice 68.2 into the sump 68 and from the secondary reactor vessel 64 though the inlet-sluice 70.2 into the sump 70 respectively. Then, liquid is transferred from the primary reactor vessel 62 and from the secondary reactor vessel 64 to the sumps 68, 70 respectively and via the devices 10 through the respective outlet ports 68.1, 70.1 into the vessels 62 and 64 respectively again in a circulatory manner thereby providing a mixing liquid flow stream.

In addition to the circulatory effect the sump 70 can also be fitted with third inlet sluice 70.4 (shown in figure 7) for access to further reactor vessels, such as the reactor vessel 62.

The installation 50 further includes an elevated launder 80 fed by aerators 82 and 84 dipping into the surface of the liquid in the annular reactor vessel 86. The aerators 82, 84 thereby raise liquid and sludge into the launder 80 which then conveys such liquid and sludge and discharges it into the settling tank 54.

In using the installation as sewage treatment plant, the primary treatment zone is thus defined by reactor vessel 62, the secondary treatment zone by reactor vessel 64 and the tertiary treatment zone by reactor vessel 66. Anaerobic treatment takes place in reactor vessel 62, anoxic treatment in vessel 64 and aerobic treatment in vessel 66. It will be appreciated that the specific physical installation may be used or adapted to suit the treatment protocol required.

In use, raw liquor to be treated is fed into the primary reactor vessel 62 via inlet pipe 86. The device 10.1 displaces liquid from the sump 68 via the outlet port 68.1, in the direction of arrows 69 within the reactor vessel 62, thereby to mix the contents of the first treatment zone. The liquid is returned to the sump 68, via the adjustable sluice 68.2, for recirculation. Treated liquid is fed from the first treatment vessel 62 into the second treatment vessel 64 via an overflow 88. Recycled liquid can also pass into the sump 68 via the port 68.3 for transfer into the first reactor vessel 62.

Similarly the device 10.2 displaces liquid from the sump 70 via the outlet port 70.1 in the direction of the arrows 71 in the secondary reactor vessel 64, thereby to mix the contents of the secondary treatment zone. The liquid is returned to the sump 70 via the adjustable inlet sluice 70.2 for recirculation. Treated liquid is from the second treatment vessel 64 into the

third treatment vessel 66 via an overflow 90. Recycled liquid can also pass into the sump 70 via the inlet port 70.3 for transfer into the second reactor vessel 64.

By suitably adjusting the gates controlling the flow through the various ports, it is possible to obtain various levels of liquid within the various treatment zones and thereby obtaining variation in the degree of circulation within zones, and recirculation and transfer of liquid between zones.

Clarified liquid overflows from the settling tank 54 as indicated by arrow 54.1 shown in figure 8. Sludge may be recirculated if desired, from the bottom of the settling tank 54, along the flow conduit 54.2 to the sump 68, or the flow conduit 54.3 to the sump 70.

It is an advantage of the aspect of the invention in the form of the device 10 as specifically described that a relatively large volumetric flow of liquid though at a low pressure is achievable by means of a stirrer type equipment that require very little maintenance and run at a low consumption of power. The advantages brought about by the device 10 are thus usefully applicable under appropriate systems such as in sewage treatment plants.

A P S van der Merwe
Patent Agent for Applicant

ZACHARIAS JOSEPH VAN DEN BERG

SHEET ONE

2003/9329

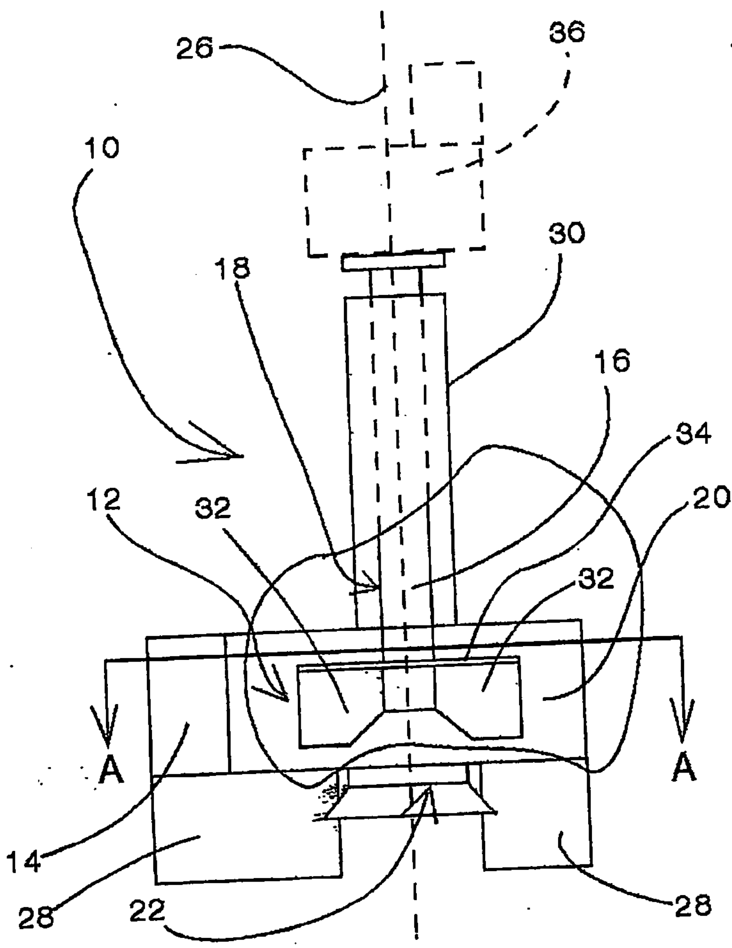

FIGURE 1

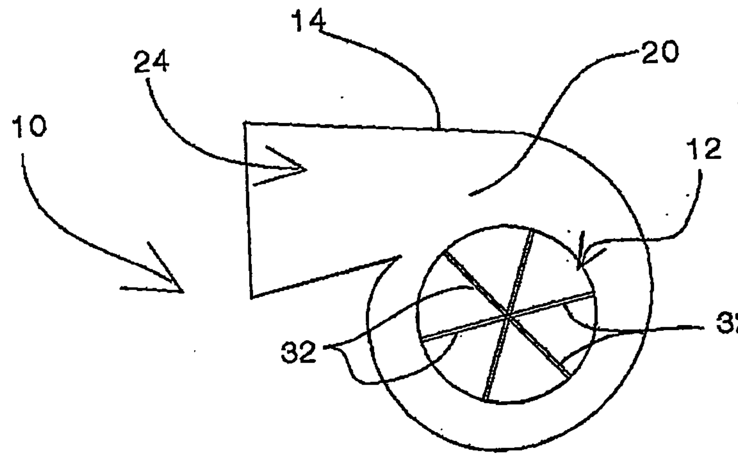

FIGURE 2

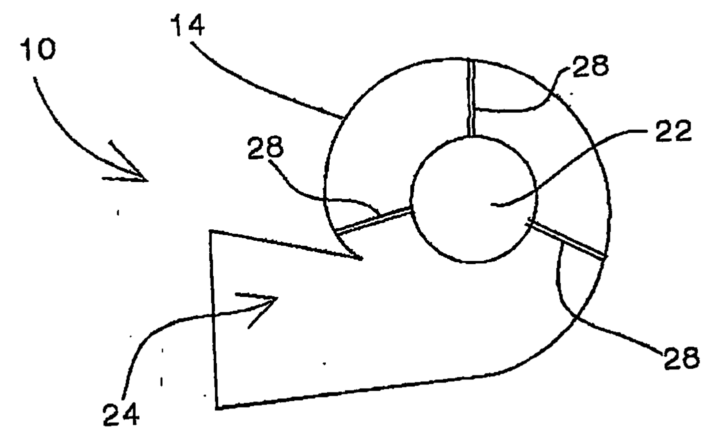

FIGURE 3

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Patent Agent for Applicant

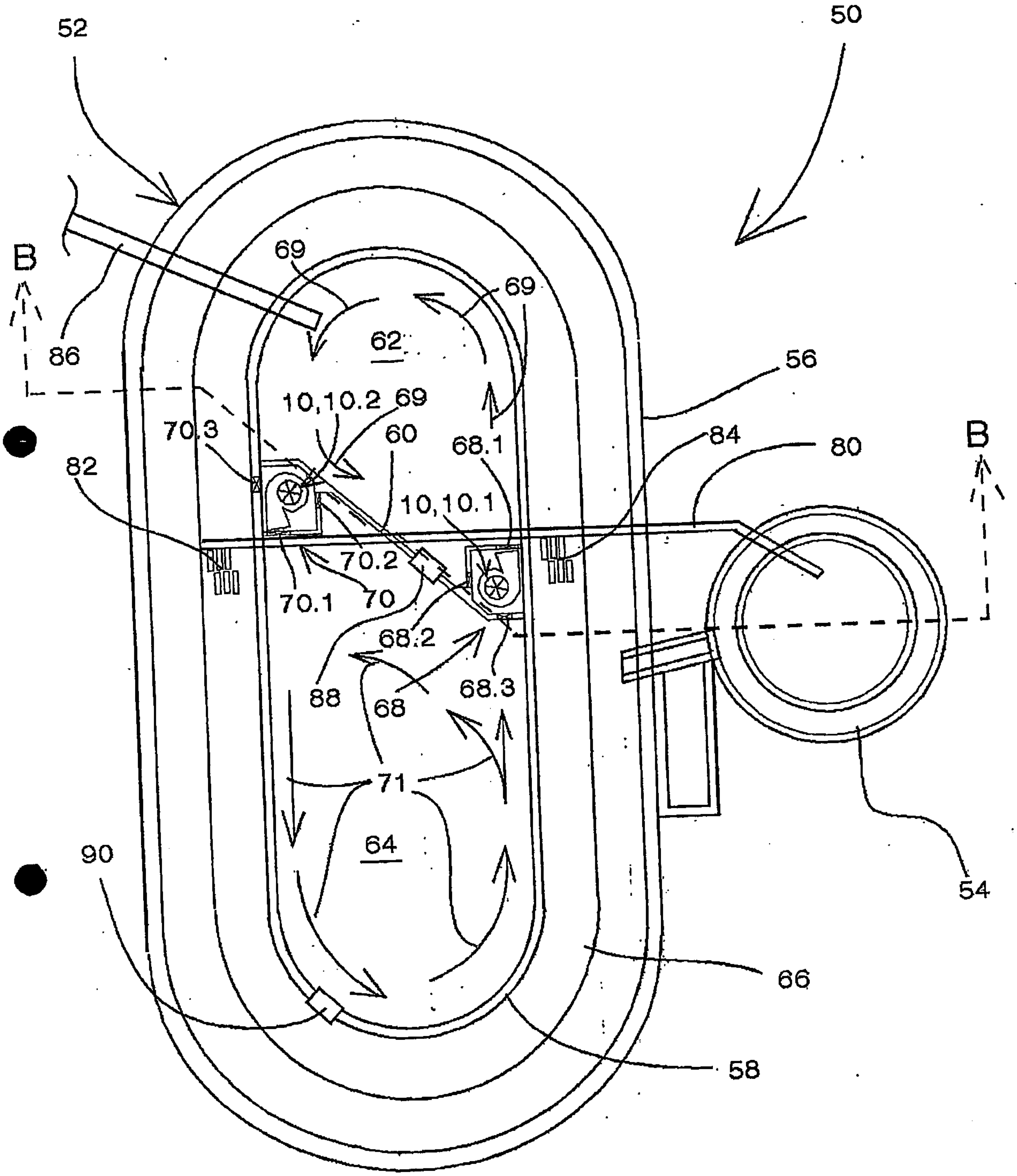

FIGURE 4

APS van der Merwe
Patent Agent for Applicant

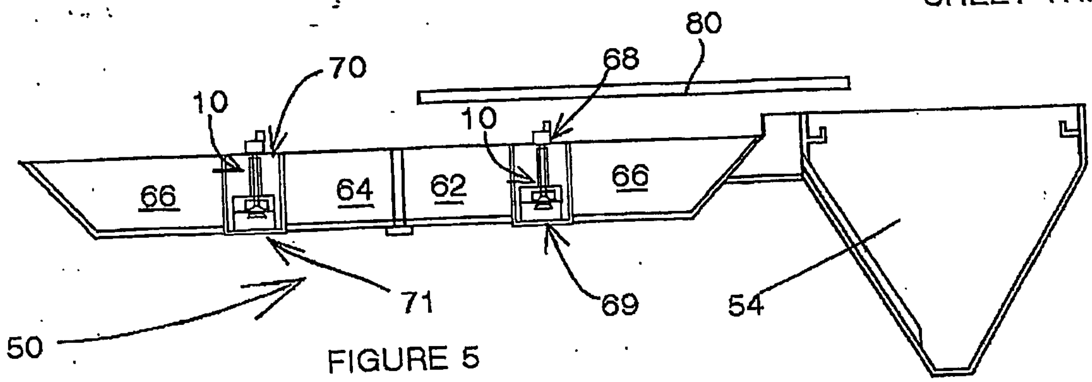

FIGURE 5

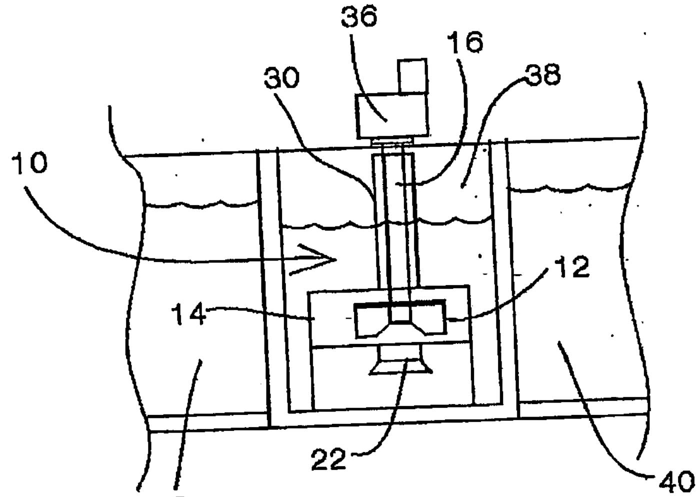

FIGURE 7

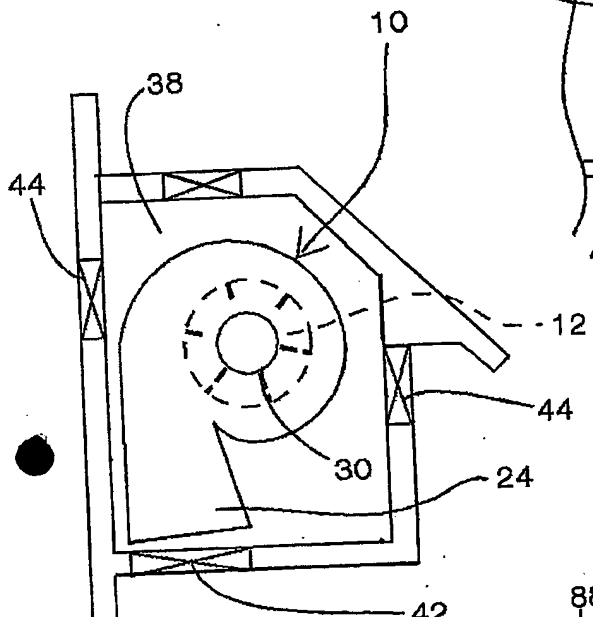

FIGURE 6

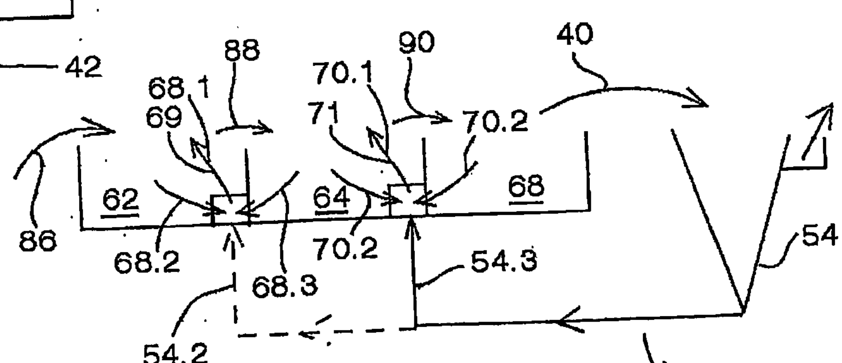

FIGURE 8

APS van der Merwe
Patent Agent for Applicant